FOREST PEST MANAGEMENT
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A BIOLOGICAL EVALUATION OF FOREST PEST PROBLEMS IN THE COLDBROOK AND PINEKNOT CAMPGROUNDS, AND THE ASPEN GLEN PICNIC AREA, SAN BERNARDINO NATIONAL FOREST

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ABSTRACT

The Coldbrook and Pineknot Campgrounds and the Aspen Glen Picnic Area on the Big Bear Ranger District, San Bernardino National Forest, were evaluated for pest problems which may affect management objectives for the areas. The major problem noted at Coldbrook Campground was western dwarf mistletoe. Management options for reducing the impact of this parasite, including 1) pruning of infected branches; 2) removing infected overstory trees to protect regeneration; and 3) thinning, are presented. Other pest problems noted were white fir true mistletoe and Elytroderma disease at Coldbrook; annosus root disease and Elytroderma disease at Pineknot; and western dwarf mistletoe at Aspen Glen.

INTRODUCTION

On December 14, 1981, John Kliejunas and Dave Schultz from the Forest Pest Management Staff met with Barbara Lee and Randy Scott of the Big Bear Ranger District to evaluate the dwarf mistletoe situation at the Coldbrook Campground and to discuss the control options available. On December 16-17, Kliejunas and Schultz re-examined the campground for additional pest problems, with the objective being to suggest alternative suppression-prevention methods for other forest pests which could be integrated into the silvicultural prescription for the campground. The Pineknot Campground and the Aspen Glen Picnic Area were also examined, with the same objective in mind.

Observations, biology of pest organisms, and management options, discussed separately for each of the three areas, follow.

COLDBROOK CAMPGROUND

OBSERVATIONS

The vegetation is predominantly Jeffrey pine with occasional white fir. Giant sequoia are planted at the entrance to the campground and in the vicinity of sites 11 and 12.

The major pest problem present in the campground is western dwarf mistletoe (Arceuthobium campylopodum), which occurs throughout the area except in the vicinity of sites 11, 12 and 13. Jeffrey pines in the understory and overstory were, in general, moderately to heavily infected, with Hawksworth 6-point dwarf mistletoe ratings of 5 and 6 common. Numerous witches' brooms were present. In some areas, densely stocked aggregations containing both infected and noninfected Jeffrey pines were present.

Many of the older overstory white fir in the campground had dead tops and were heavily infected with white fir true mistletoe (Phorandendron bolleanum subsp. pauciflorum). Elytroderma disease, caused by Elytroderma deformans, was present at low levels on a few Jeffrey pines. Root diseases were not observed in the campground. A few pines were dead or dying in the vicinity of sites 36 and 25. Some of the trees contained larvae of the California flatheaded borer (Melanophila californica) as well as pine engravers (Ips spp.) in the tops. The trees were probably predisposed to successful attack by these insects by heavy dwarf mistletoe infections and below-normal precipitation.

BIOLOGY OF PEST ORGANISMS

Western dwarf mistletoe. Western dwarf mistletoe (Arceuthobium campylopodum) infects Jeffrey, ponderosa, knobcone, and Coulter pines. Other conifers or hardwoods are not infected by this particular species. Dwarf mistletoes are obligate parasites that are completely dependent on their host for support, water, and most of their mineral and organic nutrients. They often cause the formation of "witches' brooms", dense masses of distorted branches on the host, that divert nutrients from the rest of the tree. Infection can cause growth reduction, abnormalities, mortality and predisposition to successful attack by other pests. In particular, infected trees appear to be more susceptible to attack by bark beetles and the California flatheaded borer than do uninfected trees. The dwarf mistletoe/bark beetle complex is responsible for 40 to 60% of the pine mortality in southern California during years of normal precipitation. Mortality is more frequent when other stress factors occur, such as drought, oxidant air pollution damage, or competition in overstocked stands.

Dwarf mistletoe spreads between trees and within crowns of trees by means of small seeds that are forcibly ejected into the air. Spread from overstory to understory is limited to the distance the seeds are shot, generally 20 to 60 feet, but as much as 100 feet if assisted by wind or on steep slopes. Horizontal spread in an even-aged pine stand averages one to two feet per year, with a vertical spread rate up the crown at about four inches per year.

White fir true mistletoe. The true mistletoes are usually considered to be curiosities, but they can be serious pests where individual trees are of high value. Species of Phorandendron are considered "water parasites" and are less demanding of their hosts than the dwarf mistletoes. The white fir true mistletoe (Phoradendron bolleanum subsp. pauciflorum) infects only white fir.

True mistletoe infections are spread mainly by birds - including robins, blue-birds, thrushes, and cedar waxwings - that feed on the berries. Birds digest the pulp of the berries and excrete the living seeds, often depositing them onto susceptible trees. A viscous coating and hair-like threads on the outer surface of the seeds enables them to become firmly attached to twigs and branches, where they germinate and infect the host tissues.

Young or small trees are seldom infected. In nearly all cases, initial infection occurs on tall or older trees, because birds prefer to perch in their tops. Severe buildup of mistletoe, which occurs over a period of many years, often occurs in an already-infected tree because birds are attracted to, and may spend prolonged periods feeding on, the mistletoe berries.

Trees heavily infected by true mistletoe are weakened, reduced in growth rate, and sometimes killed. Spike tops, common in white fir infected with the parasite, are susceptible to decay and breakage and hence are considered hazardous in high-use sites. Weakened trees are predisposed to attacks by insects and often die during drought or other periods of stress.

PINE ENGRAVER BEETLE

Pine engravers (Ips spp.) will breed either in the tops of live pine trees or in fresh green slash. Attacks on live trees are usually limited to trees which are suppressed, or stressed by dwarf mistletoe, root disease, drought, fire, overstocking, or the attack of other insects. If fresh slash is available in the spring, the pine engravers may build up in an area and cause locally heavy top killing by mid-summer. Attacks are made with the coming of warm weather in the spring. A new generation is produced in 6-8 weeks in the spring, to 4-6 weeks in mid-summer (August). Thus, several overlapping generations per year may be produced. The winter may be passed in any of the life stages of larvae, pupae, or adults, depending upon species involved.

Outbreaks in standing, healthy trees are sporadic and of short duration, and are often associated with some temporary stress or shock afflicting the host species, such as severe competition or sudden opening of the stand. Tree killing frequently occurs where green pine slash, which serves as breeding habitat, is left untreated during spring and summer.

Fresh pine slash caused by thinning, dwarf mistletoe control work, construction or winter storm breakage can be modified in a number of ways to make it unsuitable for pine engraver breeding. One approach to minimizing damage is to schedule slash-generating activities mostly in the late summer, fall and early winter, when the beetles are not flying or the slash has a high probability of drying out before the beetles can complete their

development. Green pine slash created during the spring and summer should be treated to prevent the buildup of pine engraver populations. Because pine engravers can complete their development in about a month under ideal conditions, treatment should be carried out soon after cutting to be effective. Some methods of slash treatment that might be acceptable in dispersed recreation areas would include lopping and scattering slash in sunny areas to speed its drying out, crushing or mashing slash with logging equipment to make it unsuitable for pine engraver breeding, or piling and burning the slash within a month of cutting. Broadcast burning the slash might work if it could be done while the slash was green without damaging the residual stand. Another method which might work is to pile slash in a sunny area and tightly cover the pile with clear plastic. If the temperature under the bark of slash in all parts of the pile reaches 120°F, all brood currently in the pile will be killed. Lower temperatures will not be effective and, where successful, this method will not prevent reinfestation of slash piles. The most acceptable methods of slash treatment in high-use recreation areas would probably be disposal by chipping or removal from the site.

CALIFORNIA FLATHEADED BORER

The California flatheaded borer (Melanophila californica) principally attacks Jeffrey and ponderosa pines, although it may be found in other pines.

It is most severe in stands located on sites where environmental stress is common. Decadent or unhealthy trees are most frequently attacked, along with an occasional top of a thrifty, vigorous tree.

Eggs are laid in bark crevices of the host tree. Newly hatched larvae penetrate directly through the bark to the phloem. Here the larvae may feed from a few months to 4 years without any apparent effect on the host tree. Should host vigor and larval abundance not allow them to succeed, the larvae cut very short galleries before they are killed. These galleries do not seriously injure the tree and are overgrown by the cambium. Should conditions be, or become, favorable for the larvae and unfavorable for the tree, the larvae develop rapidly and destroy the cambium.

Although this insect can kill trees weakened by dwarf mistletoe and root disease, its primary importance is rendering trees increasingly susceptible to bark beetle attack.

MANAGEMENT OPTIONS

1. No change in present management. Dwarf mistletoe infection levels are high in most parts of Coldbrook Campground. If nothing is done to control this disease, it will increase in intensity in trees already infected and spread to surrounding susceptible trees. Severely infected trees have a high probability of dying in 10 to 15 years. The long-term effect of dwarf mistletoe in pine is the decadence and possible loss of the host species as a major stand component. Tree aggregations with high basal areas have a

high probability of being successfully attacked by bark beetles or engraver beetles during periods of low precipitation. The probability of attack is higher in trees under stress from dwarf mistletoe infections.

2. Reduce impact of western dwarf mistletoe. Dwarf mistletoe is widespread in the Coldbrook Campground and an aggressive control program is warranted. A control program is an investment in the future health of the campground pines and, if thorough and aggressive, will reduce infection levels and mortality while increasing tree vigor and longevity. FPM funding may be available for approved dwarf mistletoe control projects. Several alternatives for reducing the impact of dwarf mistletoe in recreation sites are available.

a. Pruning of infected branches. Removing heavily-broomed branches is effective in increasing tree vigor of high-value trees in recreation areas. The objective of broom pruning is to increase a tree's vigor, and thereby to prolong its life, by removing a major source of nutrient and moisture drain. High-value trees can be pruned of brooms in the lower crown if after removal of the brooms, the tree will still have a live-crown ratio of 30% or more. When pruning, all broomed branches should be cut flush with the bole.

Pruning of all infected branches in infected trees in an attempt to eradicate the dwarf mistletoe is generally not recommended. But in exceptional cases, where attempted on high-value trees, this treatment should be restricted to trees with a Hawksworth 6-class dwarf mistletoe rating of 1 or 2 which have infections restricted to the lower 1/3 of the crown. When pruning, all branches in the lower 1/2 of the crown should be removed. This treatment should not be attempted if it will result in a tree with a live-crown ratio of less than 30%, or if the tree will be exposed to continued infection from adjacent infected trees. The trees should be reexamined every 2 years for a 6-year period and re-treated to remove previously undetected infections.

Pruning branches 1 inch or less in diameter with dwarf mistletoe plants within 6 inches of the bole is not effective because the parasite is already in the bole. For each 1-inch increase in branch diameter, the minimum safe distance for pruning increases 2 inches. For example, a 2-inch-diameter branch could be effectively pruned if no plants are closer to the bole than 8 inches.

Green pine slash caused by broom or branch pruning should be treated to reduce the risk of pine engraver (Ips spp.) buildup. Slash created in the spring or early summer should be lopped and scattered, piled and burned while green, chipped, or removed from the site.

b. Remove infected overstory trees to protect regeneration. If the objective is to save understory trees, the infected overstory trees should be removed to eliminate the source of inoculum. The understory should then be thinned and pruned to eliminate dwarf mistletoe infections. Some areas of the campground may be planted with susceptible conifers if removal of the infected overstory eliminates the sources of infection.

c. Thinning. Thinning of infected stands will aid in maintaining optimum growth of residuals and reduce stress. Following release, lightly infected residuals may vertically outgrow the dwarf mistletoe. Noninfected trees should be favored as leave trees. The removal of all trees with 6-class dwarf mistletoe ratings of 5 and 6 should be considered, because these trees have a high probability of dying in the next 10 to 15 years. Trees with bole infections should be considered for removal. Although bole infections are not serious from the standpoint of spreading dwarf mistletoe, they will deform the tree, lead to mortality in small trees, and may eventually result in open decay-infected bole cankers when the trees mature: a situation which is often hazardous in recreation areas. Treat all freshly cut stumps with borax to prevent invasion by F. annosus and treat green slash to prevent engraver beetle buildups.

d. Create buffer strips. The creation of buffer strips (areas free of susceptible hosts) should be considered at the margins of dwarf mistletoe infestations to prevent spread into or out of the treated area. Natural buffers such as roads or stand openings can be used, or susceptible species can be removed and the strip planted with nonsusceptible species.

3. Encourage tree species diversity. The planting of suitable conifer and hardwood species at Coldbrook would have several beneficial effects. Species diversity would limit the adverse effects of several diseases present. Conifers resistant to western dwarf mistletoe - such as non-pine species - or hardwoods suitable to the site could be planted in buffer strips or other openings created during dwarf mistletoe control efforts. White fir should not be planted or otherwise favored because of the presence of true mistletoe. Intermixing hardwood species such as oaks with the existing conifer vegetation would limit the effects of annosus root disease were it to become established in the area, and would probably enhance the screening and visual quality of the campground.

The objective of any pest management activity at Coldbrook Campground should be to promote the growth of healthy and vigorous, all-aged, mixed species, properly stocked stands. The consideration of present and potential pest problems and their effects on the long-term management of the area is necessary to completely fulfill this objective.

PINEKNOT CAMPGROUND

OBSERVATIONS

Vegetation consists of an overstory of Jeffrey pine and scattered white fir, with an understory of heavily stocked Jeffrey pine intermixed with black oak and white fir.

Only a low level of disease problems was observed in the campground. Conks of Fomes annosus were found in one pine stump at the margin of the opening at site 3. White fir true mistletoe (Phoradendron bolleanum subsp. pauciflorum) was noted on one understory white fir at site 10 and on two overstory firs at site 47. Very light infection levels of Elytroderma

disease, caused by Elytroderma deformans, were observed in one overstory Jeffrey pine west of site 47 on the south side of the road. Dwarf mistletoe was apparently not present in the campground.

Several white fir trees have been recently killed or top-killed by the fir engraver (Scolytus ventralis) in the campground. These trees were predisposed to attack by the recent below-normal precipitation and by competition from the dense stands of pole-sized pine trees.

BIOLOGY OF PEST ORGANISMS

Annosus root disease. Fomes annosus is a fungus that attacks a wide range of woody plants, causing decay of the roots and butt and the death of sapwood and cambium. All conifer species in California are susceptible to the fungus. Hardwood species are rarely damaged or killed. Madrone (Arbutus menziesii) and a few brush species (Arctostaphylos spp. and Artemisia tridentata) are occasional hosts. Infected pines are usually killed rather rapidly when the fungus girdles the root collar. Older true firs and incense-cedars usually survive infection for many years, although butt and root rot may become extensive, resulting in tree weakening and windthrow.

During favorable periods, the fungus forms fruiting bodies (conks) in decayed stumps, under the bark of dead trees, or in the duff at the root collars. The fungus becomes established in freshly cut stumps from airborne spores produced by conks, and then grows into the root system. The fungus subsequently spreads to healthy roots of surrounding susceptible species via root contacts. Local spread of the disease outward from an infected stump typically results in the formation of a disease center, with stumps and older dead trees near the center and fading trees on the margin. The centers continue enlarging until they reach barriers, such as openings or groups of non-susceptible plants.

Elytroderma disease. Elytroderma disease is caused by Elytroderma deformans, a fungus which infects mainly Jeffrey and ponderosa pines. It has also been reported on knobcone, lodgepole, and pinyon pines. The disease is spread by spores which are dispersed from small fruiting bodies produced on infected needles. After the spores infect current year's needles, the fungus becomes systemic in twigs. This perennial twig infection serves to reinfect each year's needles as they grow out and causes them to die and drop off the second year. Infected twigs retain only the current year's needles. The systemic infections also produce "witches' brooms" similar in appearance to witches' brooms produced by dwarf mistletoes.

The disease may cause significant growth loss when more than 40% of the crown is infected. The impact of the disease can be reduced by removing trees with more than 40% of the crown infected and by favoring resistant species. Although direct killing of mature trees is infrequent, moderate to severe infection predisposes the tree to other diseases and to bark beetle attack. In areas such as the Pineknot Campground, where infection is generally light, pruning of brooms may maintain the vigor of infected trees.

White fir true mistletoe. Discussed in section on Coldbrook Campground.

FIR ENGRAVER

The fir engraver (Scolytus ventralis) is a major cause of damage in white fir as well as other true firs. At the Pineknot Campground, the fir engraver should have one generation per year. The adults usually emerge and attack new trees during the hottest part of the year - late June through August. Attacks may occur as several distinct patterns. Trees may be killed outright, may be top-killed, or may survive repeated attacks for many years. Broods often develop and emerge without destroying enough of the cambium to kill the tree. The patch of dead cambium heals over and leaves a brown pitch pocket in the wood. The beetles carry a brown-staining fungus that is apparently essential for successful brood development.

MANAGEMENT OPTIONS

1. No change in present management. Even though pest problems are now at low levels in the campground, they will likely increase with time to the point where management objectives for the area will be adversely affected. Fomes annosus will persist in infected stumps and roots in the annosus center, and conifers on the edge will become infected and probably die after being attacked by bark beetles. Conifers planted in the annosus center will become infected and die as their roots reach old infected roots and stumps. Aggregations of Jeffrey pines with high basal area have a high probability of being attacked by bark beetles or engraver beetles during periods of low precipitation.

2. Reduce impact of Fomes annosus. Once annosus root disease is established in a stand, no direct control is available. Control, therefore, involves prevention of new centers by decreasing the risk of stump infection and silvicultural manipulations of infected stands to minimize the effects of the disease. The following alternatives are available:

a. Prevent stump infection. Application of granular borax to freshly cut coniferous stumps is effective in preventing most (90%) new infections. The chemical is toxic to the spores of F. annosus, but has no effect on existing infections. Borax application is required on all coniferous stumps cut in and near developed recreation sites (FSM R-5 Supp. 2305 and 2331.5). Application requires the submission and approval of a Pesticide Use Proposal. Review and approval of the Pesticide Use Proposal by the Chairman, Integrated Pest Management Work Group, is necessary before the borax can be applied.

b. Plant hardwoods. Revegetation of active annosus centers should be done only with resistant species. All conifers are susceptible to the fungus. Leaving the centers barren or planting them with resistant hardwoods will result in the fungus eventually dying out so that conifers can again be regenerated. Unfortunately, this will likely take 50 or more years.

Favoring the oaks already present and planting other suitable hardwood trees or shrubs will provide shade as well as establish a barrier of non-susceptible roots that may limit the spread of the current annosus center and of any centers developing in the future.

c. Thinning. Thinning of the dense stands of Jeffrey pine will minimize opportunities for root contact and subsequent spread of future annosus centers. Sparse stands or stands of mixed susceptible and resistant trees will be less subject to damage. Thinning will also increase tree vigor and thus reduce the risk of damaging activity by bark beetles. Stumps created during thinning must be treated with borax, and pine slash created should treated - such as by chipping, burning, or removing from the site - to minimize pine engraver buildups.

3. Control true mistletoe and Elytroderma disease. Because of the present low levels of true mistletoe on white fir and Elytroderma disease on Jeffrey pine in the campground, eradication of the diseases may be successful. The infected firs could be cut during thinning operations and the Jeffrey pine could be pruned. Because of their means of spread, both diseases will likely re-enter the area from outside over a period of time.

4.. Thin areas with high basal areas. As previously mentioned, thinning dense aggregations of conifers will minimize opportunities for root contact and subsequent spread of F. annosus. In areas currently free of disease, the major effect of reducing the basal area would be to increase tree vigor and reduce the risk of attack by bark beetles. Stumps created during thinning must be treated with borax to prevent colonization by F. annosus, and slash should be treated to minimize pine engraver buildups.

ASPEN GLEN PICNIC AREA

OBSERVATIONS AND DISCUSSION

Vegetation at the Aspen Glen Picnic Area consists of dominant, mature and overmature, Jeffrey pines and scattered intermediate, suppressed Jeffrey pines. Vegetation is absent from the understory.

Western dwarf mistletoe (Arceuthobium campylopodum) is present on many of the trees. Although witches' brooms are present, they are fairly high (40 to 60 feet) with a clear bole below, and pruning would be difficult. Furthermore, although removal of the brooms might prolong the life of the trees, most of the trees have infected branches above the brooms near the top of the crown and broom pruning would not eradicate the parasite.

If the management objective for the area is to prolong the life of the trees now present, removal of some of the suppressed pines should be considered. This would reduce competition and give the dominant trees a better chance for survival. The suppressed trees appear to be almost as old as the dominants and their small crowns indicate they are probably unlikely to form a suitable replacement stand.

Although pruning and thinning would probably prolong the life of the dominants, their age and crown condition suggests that they are approaching the point of pathological rotation. Planting tree species resistant to western dwarf mistletoe in the understory would provide an eventual replacement stand and would maintain vegetative cover, but the understory could compete with the overstory for water and hasten its decline. A long-term solution to the problems at the picnic site would probably have to involve extensive rehabilitation, including temporary site closure, removal of suppressed and unprunable trees, broom pruning, and planting or transplanting of replacement stock.

If you have any questions concerning this evaluation, please contact our FPM Staff. The Big Bear Ranger District has been sent information on procedures to follow for requesting dwarf mistletoe suppression funding for Coldbrook Campground. The District is encouraged to work with our staff in setting up and carrying out the project.